Fully Coupled Numerical Simulation of Mooring Forces

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Parallel finite element fluid-structure interaction solver is developed for numerical simulation of mooring forces on floating objects using both the linear spring and nonlinear cable equations. These equations act as constrains for the six degrees of freedom nonlinear rigid body dynamics equations. The Navier-Stokes equations for two incompressible fluids are used to model the dynamics of air-water interaction. The interface between the two fluids is identified by an interface function with two distinct values. The numerical method is based on writing stabilized finite element formulations in an arbitrary Lagrangian-Eulerian frame, which permits to handle the motion of the floating objects by moving the computational nodes. In the mesh-moving scheme, we assume that the computational domain is made of elastic material. The linear elasticity equations are solved to obtain the displacements. The linear spring and nonlinear cable models are used to simulate mooring forces due to buoyancy effect on floating object. Many 3D numerical examples computed on massively parallel computers would be presented.

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